

Financial and redistributive impact of reforming the old-age pension system in Belgium

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Abstract

The effects of three reforms of the Belgian old-age pension system were examined on retirement behaviour, government budget and income distribution of the old-age retired. On the basis of a large administrative micro-dataset used to estimate and simulate a discrete-time hazard model we found that reforms of the old-age pension system that penalize early retirement, and in particular penalize early retirement of the rich more than the poor, are not only the ones that enhance the financial sustainability of the system at most but at the same time lead to the strongest decrease of income inequality and relative poverty among the old-age retired. On the contrary, reforms that compensate retirement beyond the age of eligibility like the “pension bonus” recently implemented in Belgium lead to budget deficits and at the same time to a higher income inequality among the old-age retired. Finally, it was shown that the impact of reforming the old-age pension system may be limited for individuals that have the prospect of receiving occupational pension benefits, among others because in Belgium these are subject to an extremely generous fiscal treatment.

JEL codes: J26, C35, H23

Keywords : early retirement ; retirement incentives ; pension reforms ; hazard model; micro-simulation

1. Introduction

The Belgian Commission on Ageing¹ forecasted for 2030 increased government spending of 4.3% of GDP due to demographic and socioeconomic ageing. At the same time it appears that poverty in Belgium among old-age beneficiaries is increasing². The strong retirement incentives in social security programs and occupational pension plans are often cited as one of the most striking causes of early retirement and unsustainability of the system³. But less attention has been given in the literature to the impact of the design of the system on the income inequality or poverty among the old-age beneficiaries. Both elements will be analysed in this paper. This paper estimates, on the basis of a large administrative micro-dataset merged with Census data, the impact of reforms of the Belgian old-age pension system on retirement behaviour, government budget and income distribution of the retired. What we will show is that those reforms that enhance the financial sustainability at most are also those that decrease income inequality and relative poverty among the retired population at most.

¹ Report Commission Ageing(2008), Brussels.

² Cantillon et alii(1999).

³ Samwick(1998), Blondal-Scarpetta(1998), Antolin-Scarpetta(1998), Lindeboom(1998), Berkel-Borsch-Supan(2003), Coile-Grüber(2000), Chan-Stevens(2001), Grüber-Wise(1999), Grüber-Wise(2004), Deschryvere-Piekkola(2004), Spataro(2002), Börsch-Supan(2000), Ranzani(2006),....

Three reforms will be considered. In a first reform, old-age pension benefits are adjusted by 5% for each year the retirement age deviates from the normal retirement age 65 in the window 60-70⁴ (=“5% reform”). This means that a worker who retires at age 60 will have gross old-age pension benefits that are 25% lower than if he were to retire at age 65. In a second reform, old-age pension benefits are adjusted with a lump sum amount of money for each age of retirement deviating from the normal retirement age of 65 in the window 60-70(=“lump sum reform”). In order to draw comparisons with the 5% reform, the lumpsum amount is chosen such that, under the hypothesis of no labour supply adjustments, it has the same budgetary impact as the 5% reform. Although the presumed budgetary impact and predicted retirement age of these two reforms go in the same direction, the lumpsum reform is interesting since it has different effects on the income distribution of the elderly than a proportional adjustment of benefits. In addition to these two reforms, the recent implementation of the so-called “pension bonus” in the Belgian old-age pension system will be simulated (=“bonus reform”). The Belgian government wants people to work longer without penalizing early retirement for reasons of political economy. In this scenario old-age pension benefits are increased by a fixed amount of 300⁵euro on a yearly basis for each year of retirement after age 60 in the window 60-65. This means that an employee who starts to claim pension benefits at age 65 has an old-age pension that is on a yearly basis 1500 euro higher than if he were to retire at age 60⁶. The three reforms do not affect the means-tested benefit assistance. Although the amount of the bonus is not directly comparable with the ones of the other two reforms, this remains an interesting exercise⁷ since the direction of the income effect of the bonus differs from that of the two other reforms. Indeed, although the substitution effect leads in the three reforms towards delayed retirement, the pension bonus generates an income effect that induces early retirement while the 5% and lumpsum reform generate instead between 60 and 65 an income effect that delays the retirement decision. The predicted retirement age and budgetary impact for the government are thus expected to be

⁴This mechanism characterized the Belgian old-age pension system in the window 60-65 until 1992 when it was dismantled for private-sector employees. In some countries like US there exist in addition to a reduction for retirement before the normal retirement age also a delayed retirement credit for retirement after the normal retirement age. Grüber-Wise(2004), Ranzani(2006) simulated a 6% adjustment reform and Coile-Grüber(2000) a 8% adjustment reform with a reduction before the normal retirement age and a credit thereafter.

⁵ Meanwhile, because of budgetary reasons, the bonus is only available from the age of 62 and its amount has increased to 624euro on a yearly basis.

⁶ The bonus is the same for singles and married while the old-age pension is 60% of average lifetime wages for singles and 75% for married individuals if the spouse has no labour nor replacement income. The bonus is not indexed to prices nor wages

⁷ The retirement incentives of the pension bonus have also been studied by Dekkers (2006) on the basis of a fictive hypothetical employee, thus necessarily ignoring the distribution of incentives.

different. Furthermore, the bonus has a different redistributive impact as the two other reforms since it increases instead of decreases the distance between old-age pension benefits and means-tested benefit assistance.

This paper lies in the line of Grüber-Wise(1999) who show in a first stage of an international NBER research project that in OECD countries social security provisions place a heavy tax burden on wages past the early retirement age. In a second stage, Grüber-Wise(2004) affirm a causal relationship between retirement incentives and retirement and predict the effect on retirement of reforming social security. Dellis-Desmet-Jousten-Perelman(2004), Desmet-Jousten-Perelman-Pestieau(2003) conduct the analyses for Belgium. We deviate from this work in four ways. In a first place we define an individual as retired from the moment he starts to receive old-age pension benefits. In Belgium the population “at risk” of receiving old-age pension benefits may therefore be at work, unemployed, early retired or disabled. Instead Grüber-Wise(2004) define retirement as stopping to work. In a second place, we consider, in addition to their impact on retirement behaviour and government budget, the redistributive impact of reforms in more detail. In a third place, since we are not constrained by the imperatives of an international comparative analysis, we address other types of reforms recently discussed and implemented in Belgium. In a fourth place, we consider, following closely Bloemen-Stancanelli(2001), the possibility that the retirement decision may be advanced if individuals have the prospect of receiving upon retirement a large amount of occupational pension wealth. It has been suggested that the impact of reforms in the old-age pension system might be limited if the possible interaction with occupational pension systems is neglected⁸. The model in this paper estimates simultaneously the probability to claim old-age pension benefits while accounting for endogenous occupational pension wealth.

The structure of this paper is as follows. Section 2 describes the micro-data used to calculate individual retirement incentives and to relate them to individual retirement behaviour. It will be used to answer the following questions. Does the Belgian old-age pension system give financial incentives towards early retirement? (3.) To what extent do these incentives explain retirement behaviour and can we predict the change in individual retirement behaviour in the presence of reforms of this system? (4.1-4.2.) On the basis of the predicted change in retirement behaviour(4.3.), can we estimate the budgetary impact of these reforms for the

⁸ Bloemen(2008), Diamond-Hausman(1984),...

government(4.4.) and their effect on the income distribution of the retired population? (4.5.) Section 5. concludes. The appendix explains how old-age pension benefits for private-sector employees are calculated.

2. Measurement of retirement incentives and data construction

Let an individual at age t consider to retire at age R . The present discounted value of his entitlement to future pension benefits was introduced by Feldstein(1974) as:

$$SSW_t(R) = \sum_{s=R}^T \pi(s|t) d^{s-t} P_s(R) - \sum_{s=t}^{R-1} \pi(s|t) d^{s-t} \tau w_s$$

Where d^{s-t} denotes the discount factor with respect to time, $\pi(s|t)$ the conditional probability to survive until s , $P_s(R)$ the pension benefits given retirement at R and τ the payroll tax rate⁹ on wages w_s . T denotes the expected end of life. Since an increase of SSW can be interpreted as an increase of non-labour income (like an increase of initial wealth), SSW is supposed to capture the pure income effect on the retirement decision. If leisure is a normal good, an increase of SSW leads therefore to early retirement. The accrual is another incentive measure that can be derived from SSW. The accrual is the change in SSW due to the postponement of retirement with one year:

$$AC_t = SSW_t(t+1) - SSW_t(t)$$

and measures the financial gains or losses associated with an additional year of work. The accrual will be zero if an extra year of work accrues future pension rights such that it compensates that by working an extra year the worker loses one year of pension benefits and the extra year of payroll taxes that have to be made to the system. In that case the accrual does not distort the retirement decision. If however the accrual is negative, leisure becomes relatively cheaper than consumption such that there is a substitution effect towards early retirement.

⁹In reduced-form studies, also this study, payroll taxes are however not deducted since one considers that the retirement decision is not taken at the beginning of the lifecycle but rather at an advanced age and by looking ahead in the future. This view emphasizes that SSW is the present value of vested pension rights and one considers past contributions as sunk at the moment the retirement decision is taken. In addition in estimations SSW is highly correlated with the accrual and this is mainly due to the fact that the variation in SSW is driven by the variation in payroll taxes that are a percentage of wages. Therefore we do not deduct payroll taxes when calculating SSW.

In order to analyse whether SSW and accrual play a role in the retirement decision of private-sector employees, micro-data are required that allow not only the calculation of individual old-age pension rights but also their relationship to the age at which these individuals start to receive old-age pension benefits. The CREPP of the University of Liège provided us with a longitudinal administrative dataset created by the National Institute of Statistics of Belgium¹⁰. This Institute first selected 29.962 Belgian fiscal households (or 50541 individuals) with at least one member in the 50-64 age range in 1996. This sample has been connected to the Income Tax Returns(=ITR) for the years 1990¹¹-1996 and the Individual Pension Accounts(1956¹²-1996) by means of the national identification number.

The ITR contain all the information necessary to calculate the income tax such as household composition, number and type of dependants in the household, age, gross labour income, replacement incomes (unemployment, conventional early retirement, disability or illness, old-age pension or survivor benefits), housing wealth, occupational pension benefits, employee contributions in occupational pension plans, private voluntary savings of household members¹³. The ITR show in particular at what age individuals start to receive old-age pension benefits.

The Individual Pension Accounts contain all the information necessary to calculate gross old-age pension rights of private sector employees such as the number of days of work, the number of days spent on replacement incomes and the gross wages for every year of the career since 1956. We transform the latter, on the basis of the ITR, into net pension rights and converted them into real terms. Finally, on the basis of life expectancy tables¹⁴, one can calculate for every private-sector employee in the sample for each possible retirement age SSW as a stream of net old-age pension benefits, discounted by a real interest rate of 3%¹⁵ and adjusted by his survival probability. For married workers this calculation is more complicated, since we must, in addition to old-age pension benefits, allow for survivor benefits in case one of the spouses would die. In that case, SSW consists of a stream of old-age pension benefits, adjusted by the joint survival probability of the couple plus a stream of

¹⁰The original dataset has been set up and used in the context of an international NBER research project. It is also presented in Dellis-Desmet-Jousten-Perelman(2004) and Desmet-Jousten-Perelman-Pestieau(2003).

¹¹ The tax files were filled in during 1991-1997 but concern income generated in 1990-1996.

¹² This is the year in which the old-age pay-as-you-go pension system for private-sector employees was born.

¹³ Income data are converted into real data with year 2002 as reference year.

¹⁴ Deboosere-Gadeyne(2002) constructed such tables on the basis of the Census of 1991.

¹⁵ Since the interest rate is not estimated within the model, it has to be fixed a priori. As usual, we set it at 3%.

survivor benefits, adjusted by the survival probability of the widow(er). To calculate the accrual forces us to make forward projections of wages: as in Grüber-Wise(2004) and Grüber-Wise(1999), we assume real wage increases of 0%.

Interestingly, the ITR and Individual Pension Accounts could be merged with the Census of 1991¹⁶ that has a response rate of more than 99% and contains information on education level, professional status of the household head and his spouse (blue collar, white collar, civil servant, self-employed, ...) and sector of activity they work or worked in (chemical industry, banking, insurance, agriculture, socio-cultural services,...). The construction of the dataset is summarised in table 1.

Table 1: data construction	
Dataset	Number of individuals
ITR 1996	50541
ITR 1995	48752
ITR 1994	47291
ITR 1993	47332
ITR 1992	46907
ITR 1991	46346
ITR 1990	46416
Census of 1991	50136 ¹⁷ (matching with ITR 1996:99.2%)
Individual pension accounts 1956-1996	31400 ¹⁸ (matching with ITR 1996: 62%)
Private-sector employee in 1991	9985 ¹⁹ (matching with ITR 1996:20%)

Of the dataset are only selected the individuals who declare to be private sector employee at 1st of March 1991 in the Census. The reasons are the following. First, we do not consider the non-statutory employees in the public sector as private-sector employees, since they frequently are nominated as civil servant just before retiring and thus end up in a different old-age pension system with different retirement incentives what could give rise to measurement errors in the incentive structures. Second, a lot of self-employed worked in the beginning of their career as private sector employee but more than 90% stopped working as private sector employee at last at age 42. Although these mixed careers accumulated some

¹⁶ Every 10 year the Belgian government organizes a Census. Questionnaires are sent by post to every Belgian citizen and they are afterwards personally collected by local civil servants.

¹⁷ Number of individuals selected from ITR 1996 and in Census of 1991.

¹⁸ Number of individuals selected from ITR 1996 and for at least one year in individual pension accounts 1956-1996.

¹⁹ Number of individuals selected from ITR 1996 and for at least one year in individual pension accounts 1956-1996 and private sector employee in 1991.

rights in the old-age pension system of employees besides the self-employed old-age pension system, that is governed by different rules and for which micro-data are scarce, we do not consider them as private-sector employee in order to avoid measurement errors in the incentive structures.

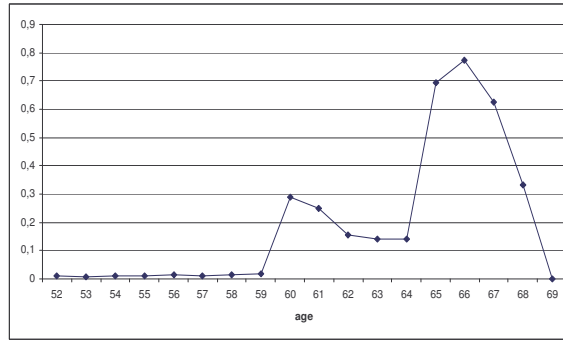
There was the issue of whether one should include observations of men that retire through conventional early retirement schemes. On the one hand, the age at which the early retired transit towards the old-age pension scheme is in Belgium fixed by law at 65: early retired men²⁰ are thus never at risk of claiming old-age benefits. On the other hand, if we excluded all observations of men who ultimately end up in a conventional early retirement scheme, the selection would be based on the future state of individuals. Therefore, we included the working-year observations of employees that end up as early retirement beneficiary and right-censor them at the moment they become early retired. We analysed the sensitivity of the results to the inclusion or exclusion of the working-year observations of employees who end up as early retired and found the results are very similar.

On the basis of our sample, figure 1 shows the hazard rate into old-age retirement²¹.

Figure 1: hazard rate into old-age retirement by age

²⁰This is not an issue for female early retirement beneficiaries that transit towards old-age pension since they choose the age of claiming old-age benefits: during the period in which they are early retired, they are at risk of claiming old-age benefits.

²¹ An individual is defined retired if he receives old-age pension benefits *and* his next year labour income is less than the earnings test *and* old-age pension benefits are higher than receipt of next year social security benefits (unemployment, disability, early retirement). The use of “next year labour income” avoids measurement errors by which individuals are erroneously qualified as non-retired while they are effectively retired. Suppose f.e. an individual that becomes 60 in the end of the year, f.e. in November. His yearly pension benefits for that year are those from November and December while from January until November he receives labour income. Since his yearly labour income outweighs his yearly pension income, one could erroneously qualify him as employed while he definitively retires at 60. In our definition of retirement, we group 1) those that transit from work to old-age pension, only from age 60 on and no cumul with other social security benefits is allowed; 2) the survivor pensioners, available since age 45 and a cumul with other social security benefits is allowed. The surviving widows/widowers often receive very low pensions if they continue to work and/or cumulate other social security benefits. From the moment that their main income comes from a survivor pension, we consider them as retired.



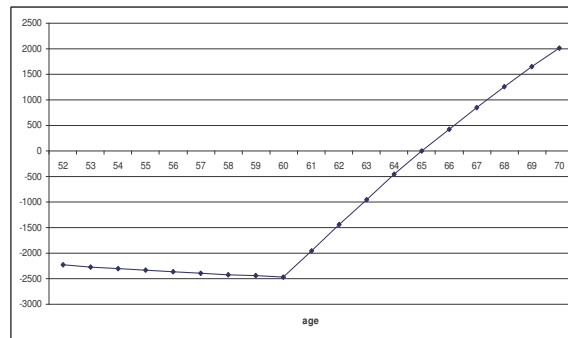
Of the population that is at risk at the age 59, 30% retires at age 60. This corresponds to the age of eligibility of the old-age pension system. The fact that the peak at age 65 is much higher than the peak at age 60 is simply because the population at risk of exiting is much higher at age 60 than at age 65. The next section will show that the ages 60 and 65 that correspond to spikes in the hazard rates can be associated to changes in financial incentives to retire.

3. Does the Belgian old-age pension system contain retirement incentives?

The dataset presented in the previous section allows to calculate for private-sector employees SSW and accrual for every possible retirement age. We do so for the current system, called “status quo” (3.1.) and a reformed system (3.2.). Three reforms, presented in the introduction, are under consideration: the 5% reform, the lumpsum reform and the bonus. In the lumpsum reform, everybody who has the same retirement age sees his gross old-age pension rights before age 65 reduced with the same amount and after age 65 increased with the same amount while for the 5% reform, the amount of the adjustment depends not only on the age of retirement but also on the level of benefits. To guarantee that the lumpsum reform has the same budgetary impact as the 5% reform, under the hypothesis of no labour supply adjustments, we calculated the lumpsum amounts for each possible retirement age as the mean difference between yearly old-age pension benefits under the status quo and yearly old-age pension benefits under the 5% reform. The resulting lump sum amounts applied to yearly gross old-age pension benefits are in figure 2²². Of course these depend on the particular wage and retirement age distribution of the individuals in our sample. The only reason we simulate this reform is to show, for the same budgetary impact, that the lumpsum reform penalizes the poor more than the rich, compared to the 5% reform.

²² Note that before the age of 60 there is no additional adjustment of old-age benefits anymore since 60 is the age of eligibility for old-age benefits.

Figure 2: Lump sum reform amounts by retirement age(in euro)

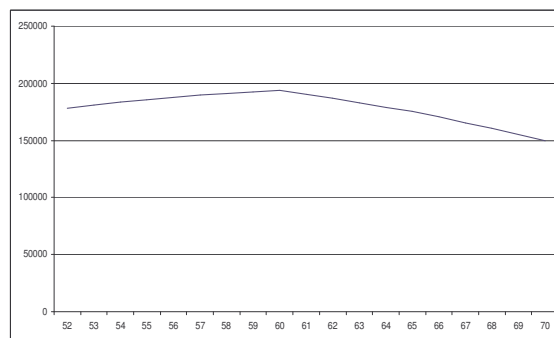


All calculations are done on the 9985 private-sector employees, but **before they have been matched with the ITR 1990-1996**. The idea is to describe how incentives will evolve **if one would** continue to work until 70 and to avoid that this descriptive analysis be affected by differential selection into the sample at each age.

3.1. Old-age retirement incentives in the status quo

Figure 3 shows the mean SSW for each possible retirement age. In general, an individual that stops accumulating old-age pension rights f.e. because he becomes inactive at the age of 55 can only start to take up his old-age pension benefits at the age of 60. Retirement before age 60 is however possible for survivor benefit beneficiaries.

Figure 3: mean SSW by retirement age(in euro)



Additional years of work affect SSW in different ways. First, as long as the career lasts for fewer than 40 years for women and 45 for men, benefits are increased by a factor of 1/40 respectively 1/45. Second, in case of a complete career an additional year of work with strong wage increases can replace a previous low-wages year. Third, an additional year of work after the age of eligibility of 60 implies fewer years over which benefits can be claimed. Fourth, a delay in receiving benefits raises the probability that the employee might die before being able to collect benefits. As can be seen clearly in the graph above, mean SSW increases slowly until the age of eligibility to decrease rapidly thereafter. The fact that SSW decreases

beyond age 60 indicates that working is discouraged by the old-age pension system. Working an additional year increases pension benefits but not enough to compensate the loss of one-year of pension benefits. Obviously, when the career is complete²³ and beyond age 65 when means-tested benefits become available for men, SSW declines even more quickly.

To get an idea of the extreme heterogeneity of retirement incentives across individuals, one can look at the 10th and 90th percentiles: beyond age 60 the decrease in SSW is very slow for those with a low SSW compared to those with a high SSW. Inspection of our dataset reveals this is primarily due to the fact that those in the 10th percentile have often an incomplete career and/or wages below the ceiling and those in the 90th percentile have often wages that reach the wage ceiling.

Figure 4: 90th percentile SSW by retirement age(in euro)

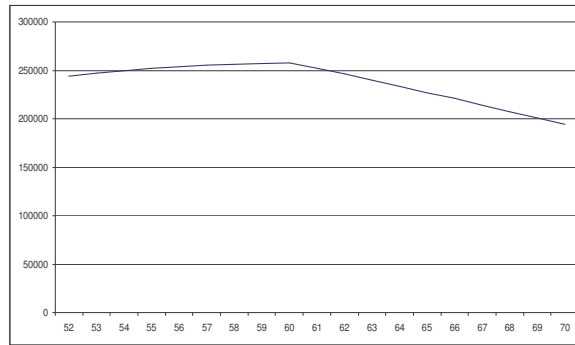
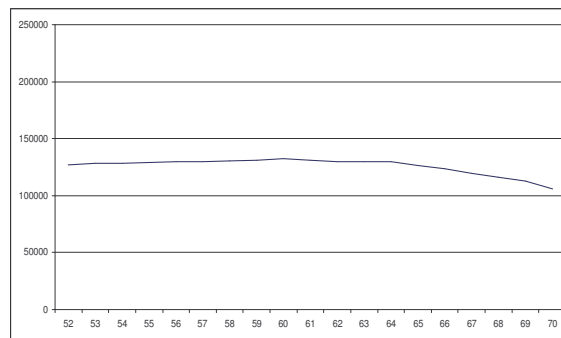


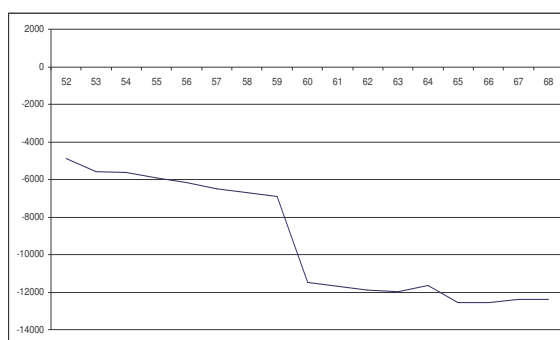
Figure 5: 10th percentile SSW by retirement age(in euro)



The fact that the old-age pension system is actuarially unfair at the margin is reflected in a negative accrual for all possible retirement ages. The accrual is negative before age 60 since the pension rights grow by only 1/45 while payroll taxes still have to be paid. At the age of eligibility of 60, there is in addition a clear downward jump in the accrual. From then on, working one more year means also the loss of one year of pension benefits.

²³In the dataset there are employees that started to work at age 14 and have completed their career before 60.

Figure 6: mean accrual by retirement age(in euro)



It may be that the mean accrual is negative but that, due to the heterogeneity of accruals among individuals, some employees do face positive accruals.

Figure 7: 90th percentile accrual by retirement age(in euro)

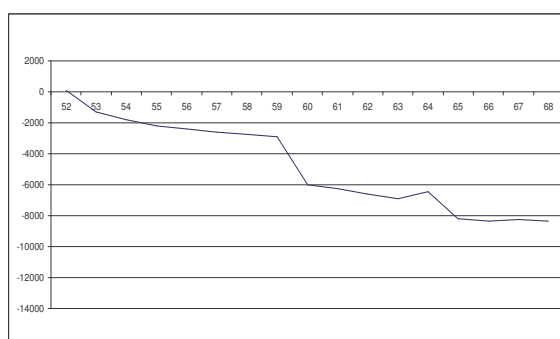
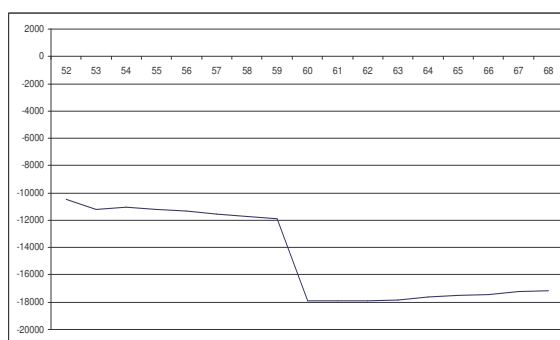


Figure 8: 10th percentile accrual by retirement age(in euro)



The 90th percentile accrual is however mainly²⁴ negative: this means that nearly the whole population of private sector employees faces incentives towards early retirement. It corresponds to individuals with wages under the ceiling and/or incomplete careers. Note also the decrease in the accrual at age 65 at which means-tested benefits become available for men. The 10th percentile accrual on the other hand corresponds to individuals with the highest

²⁴ Desmet-Joustien-Perelman-Pestieau(2003) find similarly that the highest decile of the accrual has negative values.

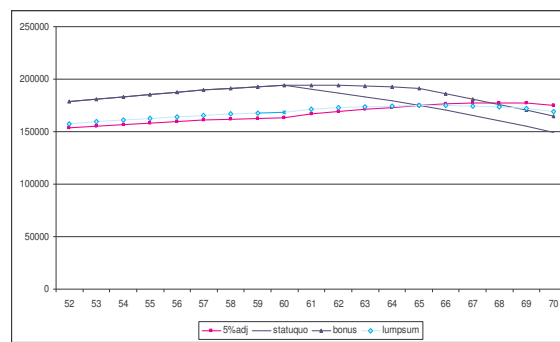
wages that are only taken into account up to the wage ceiling for calculating benefits while at the same time they pay high payroll taxes that are due on all wage income²⁵.

3.2. Old-age retirement incentives in the reformed pension system

As shown above, the old-age pension system is not actuarially fair at the margin since paying one more year payroll taxes and the corresponding loss of pension benefits during that year is not sufficiently compensated by accrued pension rights. In this section the focus is on the retirement incentives that prevail under a reformed old-age pension system.

In figure 9 the evolution of mean SSW over age of three reformed old-age pension systems is compared with the mean SSW of the status quo.

Figure 9: mean SSW by retirement age(in euro)



The 5% and lumpsum reform cause the mean SSW to increase with age and shift the peak in SSW from age 60 to 65. Compared to the status-quo, SSW starts at a lower amount for retirement ages before 65 but afterwards it is higher. It is not surprising that in the age range 60 to 65 SSW increases if benefits are adjusted by 5% or a lumpsum amount while it decreases under the status quo.

Compared to the status-quo, the bonus leads to a higher mean SSW after age 60²⁶. The amount of the bonus is however insufficient to shift the peak in the 90th percentile and mean SSW to the right: the peak stays at age 60, except for the 10th percentile SSW. This is a major difference with the other two reforms. The effect of the bonus is relatively stronger on

²⁵ Desmet-Jousten(2003) note that “the Belgian wage-earners scheme takes on Beveridgean characteristics for people over the wage ceiling. High income workers face high contributions on their labour income and hence the adjustment to keep SSW unchanged is much higher than for individuals below the ceiling facing a rather Bismarckian system”.

²⁶Since the bonus is only attributed after 60, it has no effect on SSW before age 60.

employees with a low SSW than a high SSW. This has to do with the fact the bonus is a fixed amount and thus has more effect on individuals with low pension benefits.

Note also that before age 65, the 90th percentile SSW of the 5% adjustment is lower than that of the lumpsum reform. This is because for individuals with a high SSW a reduction of 5% is more penalizing than a reduction with the lumpsum amount. Beyond age 65, the 90th percentile SSW of the lumpsum reform lies below that of the 5% reform since for individuals with a high SSW an increase of 5% is more than an increase with the lump sum adjustment. For individuals with a low SSW (10th percentile SSW) one can hardly see a difference between the impact of the lumpsum and 5% adjustment reform because these reforms mechanically induce a high proportion of individuals to the means-tested benefits of which the amount is insensitive to these reforms.

Figure 10: 90th percentile SSW by retirement age(in euro)

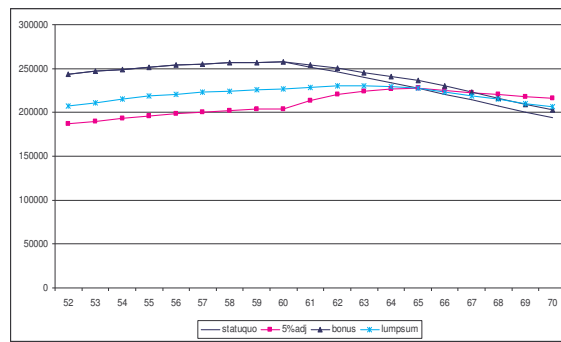
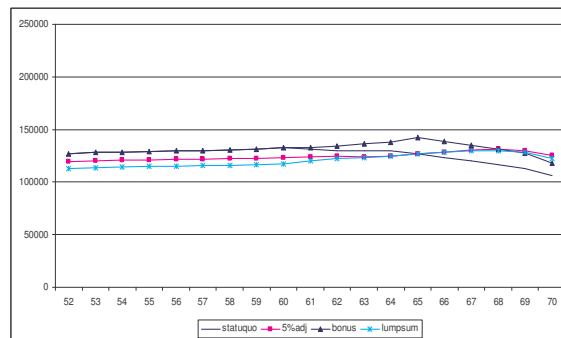


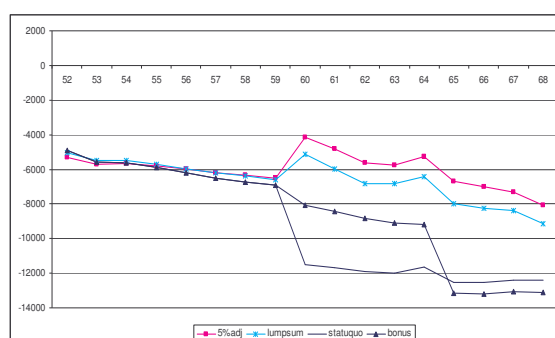
Figure 11: 10th percentile SSW by retirement age (in euro)



Compared to the status-quo, the 5% adjustment of benefits enhances the actuarial fairness at the margin: instead of a downwards kink in the accrual at age 60, the accrual significantly increased. The discontinuity in the accrual profile at age 60 is due to the fact that in the range 60-65 the adjustment factor increases with 5% for each age deviating from the pivotal age of 65 but below age 60 there is no additional adjustment of 5%. Furthermore, the accrual

decreases beyond 60: the closer one comes to the age of 65 the higher the actuarial adjustment factor should be in order to keep the accrual constant with age.²⁷

Figure 12: mean accrual by retirement age(in euro)



Compared to the other 2 reforms, the pension bonus has a much smaller effect. To generate a similar incentive structure as the 5% reform, the amount of the bonus should be higher and be differentiated in function of income. In addition since it is limited to the age range 60-65, the bonus leads to a strong downwards jump in the accrual at age 65. This is even more pronounced in the 90th percentile accrual.

For those in the 90th percentile (those with the lowest incentives to retire), the bonus has its full effect at least until age 65. The bonus eliminates the dip at age 60 but beyond age 65 the bonus is not attributed anymore and leads to an even stronger dip at age 65. On the contrary, the individuals in the 10th percentile accrual are those who receive the lowest increase of old-age benefits when they work one more year. Among them are concentrated the individuals who because of high wages, attained the wage ceiling and pay high payroll taxes. For them, the bonus is too low to eliminate the downwards jump in the accrual at the age of 60.

When comparing the 10th and 90th percentiles accruals, one sees again that the lumpsum reform has a very similar effect as the 5% reform on the 90th percentile accrual (with low retirement incentives) while it has a much weaker effect on individuals in the 10th percentile accrual (with high retirement incentives). The latter correspond to individuals with high wages that attain the wage ceiling and pay high payroll taxes.

²⁷Desmet-Jousten(2003) find that in order to obtain actuarial fairness at the margin, the total adjustment factor of benefits should be 10% at age 64 but only 6% at age 60.

Figure 13: 90th percentile accrual by retirement age(in euro)

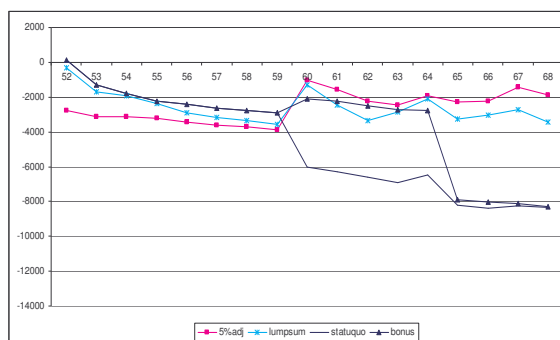
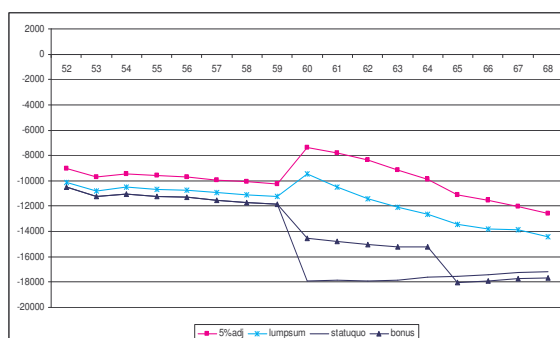


Figure 14: 10th percentile accrual by retirement age (in euro)



We conclude that of the 3 reforms the 5% reform gives the strongest work incentives and the bonus the lowest. The 5% reform in addition has a strong impact on the incentives of the high income individuals while the lumpsum reform and the bonus have a relatively stronger impact on the incentives of the low income individuals.

4. Impact of a reform of the old-age pension system

It was shown that the Belgian old-age pension system contains incentives to retire early and that moving towards a system that is actuarially fair at the margin alleviates these retirement incentives. In this section one explains the discrete-time hazard model that will be used (4.1.) to estimate to what extent these retirement incentives in the old-age pension system explain observed retirement behaviour (4.2.). The estimated coefficients can then be used to simulate the retirement age (4.3.), budgetary impact (4.4.) and redistributive impact on the incomes of the retired population (4.5.) of the three previously introduced reforms of the old-age pension system.

4.1. The model

Since we consider retirement in the old-age system as an irreversible decision²⁸ that is taken conditional on not having retired before, the hazard model is a natural candidate to model this event, following Schils(2006), Spataro(2002), Piekola-Deschryvere(2004), Euwals-Vanvuuren-Wolthoff(2006), Meghir-Whitehouse(1997), Lindeboom(1998), Antolin-Scarpetta(1998) and Diamond-Hausman(1984). Although in the real world retirement can occur at any time, the model is in discrete time since our data are grouped into intervals of one calendar year. Jenkins(1995) showed that the procedure to estimate a discrete-time hazard model is equivalent to the estimation of a panel data model with a sequence of binary dependent variables. One can define the probability that an employee $i=1,\dots,N$ retires in the calendar year $t=1,\dots,T$ after a career of duration d as $P_{it} = \text{Prob}(y_{it}^* > 0)$ that results from the latent model $y_{it}^* = \beta x_{it} + f(d) + c_i + u_{it}$ where y_{it}^* denotes the unobservable propensity to claim old-age pension benefits, β is the vector of coefficients associated with x_{it} , a vector of exogenous and possibly time-varying explanatory variables that will be discussed below. $f(d)$ is a function of duration dependence that represents the baseline hazard and captures number of years of the career²⁹. Note that the career covers, on the basis of the individual pension accounts, not only the years effectively worked but also the years assimilated to worked years since, as already said, the population at risk of claiming old-age benefits may be at work, unemployed, disabled or early retired. We are thus estimating a binary response model where the dependent variable

²⁸ For single spell data, estimation results are sensitive to misspecification of the distribution of unobserved effects. However, claiming *old-age* pension benefits is a decision that occurs only once: only 0.7% of those receiving in a given year old-age pension benefits receive in the following year labour income and could be considered as reentry in the labour market. In 80% of these cases it concerns survivor benefits before age 60.

²⁹ Often discrete-time hazard models assume a piecewise constant baseline hazard: duration dummies are used for each possible duration of the employment spell. Duration itself is “proxied” by the time period between the age at which one may consider to retire (50 or 55) and the effective retirement age(Buttler-Huguenin-Teppa(2004), Euwals-Vanvuuren-Wolthoff(2006), Schils(2006), Piekola-Deschryvere(2004), Antolin-Scarpetta(1998), Diamond-Hausman(1984)) or by age itself(Spataro(2002))). In that case it becomes difficult to see the difference, except for the distribution in the random error terms, with binary response panel data models that include age dummies to control for a pure age effect. Coile-Grüber(2000) note: “we have also estimated these (binary probit) models (with age dummies) as Cox proportional hazard models and the results were very similar; this is not surprising, given that the models all include a full set of age dummies, which pick up the same factors captured by the baseline in the hazard model”(p.23). In our paper, we included, like Meghir-Whitehouse(1997) and Lindeboom(1998), both duration of career and an age variable, because people of the same age with different careers may have a different retirement behaviour.

$$y_{it} = \begin{cases} 1 & \text{if } y_{it}^* > 0 \\ 0 & \text{else} \end{cases} . \text{ It takes account of right-censored spells under the assumption they are}$$

randomly censored. If the random error term u_{it} is logistically distributed³⁰, this means:

$$P_{it} = \frac{\exp(c_i + f(d) + \beta x_{it})}{1 + \exp(c_i + f(d) + \beta x_{it})} . \text{ We allow for unobserved individual-specific time-constant}$$

heterogeneity³¹ captured by c_i . As explained by Lancaster(1990), one might expect indeed that there are individual-specific unobserved effects like ability, motivation or general attitudes that make individual have a high propensity to retire while others not, the population at risk may be over time more and more composed of individuals that have a low propensity to retire. This sorting effect can bias not only the baseline hazard but also β . The inclusion of an unobserved effect allows to correct for this sorting effect.

Explanatory variables

One of the crucial explanatory variables in this model that one seeks to identify are financial retirement incentives, like SSW and accrual. Besides retirement incentives, we include individual observed characteristics such as education level of the employee, region where he lives (Brussels, Wallonia or Flanders) and the sector he works or worked in. The age difference between the individual and his eventual partner was included to account for

³⁰ Spataro(2002) and Coile-Grüber(2000) estimated discrete time hazard models with an extreme value, normal and logistic random error term and got very similar results. Deschryvere-Piekkola(2004) find that the hazard ratios in an extreme value model are of different magnitude than the marginal effects from a probit model. Their comparison is however not clear since the reference individual to calculate hazard ratios is not the average individual used for calculating marginal effects. Sueyoshi(1995) explores the implications of specifications for hazard behaviour and notes that “practical experience with discrete-choice models suggests that the predicted probabilities and hence the goodness-of-fit tests for the models will generally be quite similar.” Apart from goodness-of-fit tests, “results from the logit and proportional hazard specifications will be quite similar. In contrast, estimates from a probit-type group duration model should depart significantly from both of these specifications, exhibiting covariate effects that are decidedly non-proportional” while “logistic models are only slightly less proportional than the extreme value specification”. Applied to retirement models, this means according to Euwals-Vuuren-Wolthoff(2006): “Probit regressions per age allow for a different impact of the financial incentives at different ages. In our hazard rate model we restrict the impact of a given financial incentive to be the same over different early retirement ages”(p.16).

³¹ We found only very few examples in the retirement literature that allow for individual-specific effects. Euwals-Vuuren-Wolthoff(2006), Schils(2006) and Meghir-Whitehouse(1997) assume in a hazard model a discrete mass point and Diamond-Hausman(1984) a gamma distribution for the unobserved effect and all found significant unobserved heterogeneity. Spataro(2002) assumes in a hazard model a normally distributed unobserved effect with mean zero that is not significant. Borsch-Supan(2000) find in a panel probit that unobserved heterogeneity (AR(1),MA(1)) biases the measurement of incentive effects.

possible coordination of household members of their retirement decision.³² As time-varying variables we include age of the private-sector employee, year dummies, housing wealth and the number of dependent children and disabled.³³ Finally, we included a dummy for employees who have received at least once in the sampling period unemployment or disability benefits.

Endogeneity issues

Endogeneity in this model may arise in the first place due to an omitted variable bias where the omitted variable is correlated with an explanatory variable of interest leading to inconsistent estimation of the coefficients. Boskin-Hurd(1978) are one of the first to consider what is known as “the identification problem of SSW”, that is the possibility that SSW is endogenous since it is correlated with unobserved individual tastes for work. Those with a taste for work would have worked hard all their life, have higher wages and hence be eligible for larger benefits and thus a higher SSW. If one is unable to separate preferences for work from financial incentives, one could thus end up with a negative coefficient of SSW suggesting that a higher SSW decreases the probability to retire while the lifecycle theory suggests instead a positive income effect: a higher SSW should increase the probability to retire if leisure is a normal good. Chan-Stevens(2001) show that neglecting this identification issue, as sometimes happens in the literature³⁴, may lead to significant bias in the estimated coefficients. There are at least two possible solutions³⁵. A first possible solution is a 2SLS procedure in which SSW is replaced by an instrumental variable that is highly correlated with SSW but not with “tastes for work”. If f.e. our dataset would cover a period before and after a pension reform, this would create interesting conditions for a natural experiment, as in Krueger-Pischke(1992), Ranzani(2006) and Meghir-Whitehouse(1997). They use interactions between birth cohorts and time dummies as identifying instruments of SSW. In

³² Desmet-Lozachmeur(2002) showed that in Belgium 79% of men and women stop working in the same year or with a difference of one year. This may be for various reasons (like complementarity in preferences for leisure or spillover effects of retirement incentives on the partner) that we do not analyse here.

³³ A priori, these can be exogenous or endogenous. To test whether the fact of retiring might influence future housing wealth and household composition, we regress these variables on lagged retirement status and all other observed characteristics and found the former is not significant. Housing wealth and household composition are therefore considered as exogenous.

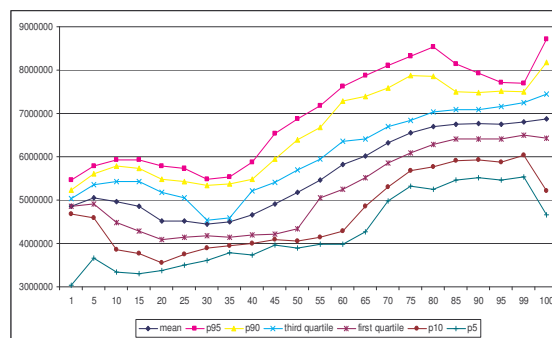
³⁴ Euwals-Vanvuren-Wolthoff(2006), Piekkola-Deschryvere(2004), Boskin-Hurd(1978). Borsch-Supan(2000) allows for an individual specific random effect that is supposed to capture preference for leisure but that is implicitly supposed to be uncorrelated with SSW..

³⁵ Schils(2006) uses on the basis of survey data a variable “wants a reduction in working hours” as a proxy for the impact of individual preferences for working

that case, the main source of variability of SSW is the one induced by policy changes over time that affect the level of benefits. Since however our data fall between two pension reforms, we opt for the second solution that is to control directly for a proxy for “tastes for work” in x_{it} . A good proxy should be sufficiently correlated with tastes for work such that once it is included, SSW is no more correlated with the unobserved effect³⁶. If one looks at the way how SSW is constructed, the obvious input in SSW that might be correlated with unobserved tastes for work is average lifetime wages as suggested by Coile-Grüber(2000), Grüber-Wise(2004) and Spataro(2002). They include average lifetime wages directly in the equation in order to capture unobserved taste for work and allow average lifetime wages to be time-varying in order to allow for upward wage increases. A little bit different is the notion of “permanent income” of Diamond-Hausman(1984) that we used: a time-constant concept of average lifetime wages based on effectively worked periods where they “excluded from the averaging procedure years when the individual reported himself as retired, out of the labor force for much of the year or working only part time”(p.84).

The question that arises is how much variation is left in SSW, if one controls for average lifetime wages? The following figure plots mean, 90th, 10th, 95th, 5th percentile, first and third quartile of SSW against the distribution of average lifecycle wages in percentiles. This shows that SSW is a non-linear function of average lifetime wages. The important thing is the extreme variation in SSW across individuals with the same level of average lifecycle wages.

Figure 15: Distribution of SSW in function of average lifecycle wages



A first reason why the relationship between SSW and average lifecycle wages is not linear and why there is so much variation among individuals is because yearly old-age pension benefits are not linear in average lifecycle wages: the old-age pension system has *for every year* of the career a floor and a ceiling and old-age pension benefits assimilate periods of inactivity to periods of activity while these are not taken into account in the calculation of

³⁶ See Wooldridge(2002) p.63-65.

average lifecycle wages. Besides that, there are several reasons why, even for individuals that would have *for every year* of their career a wage between the floor and the ceiling and have no assimilated periods, SSW is not a linear function of average lifecycle wages: 1) Average lifecycle wages is time-constant for each individual³⁷ while SSW changes for each individual over time; 2) average lifecycle wages is gross while SSW is constructed on the basis of net pension benefits, after a progressive income tax; 3) SSW integrates means-tested benefits in contrast to average lifecycle wages 4) SSW is a discounted sum of benefits in contrast to average lifecycle wages; 5) SSW is an expected discounted sum of benefits, adjusted by survival probability in contrast to average lifecycle wages. It are thus the non-linearities that come from exogenously imposed and complex pension legislation³⁸, income tax legislation and the conversion into expected and into discounted wealth, that lead to a strong variability of SSW across individuals and that is supposed to identify SSW. As noted by Gruber-Wise(2004), the full effect of incentives may however be understated when one controls separately for average lifetime wages since the latter also determines in part the value of the incentive measures.

A related problem arises with the identification of the variable age. A priori, age may capture deteriorating health status, increasing preferences for leisure, social norms and/or eligibility rules in pension systems³⁹. Since deteriorating health status, increasing preferences for leisure and social norms may be interesting determinants of retirement we want to include a variable for age that can be considered as a proxy. However, we would like that the age variable does not absorb eligibility rules like eligibility ages 60 or 65. The piecewise-constant hazard models that work with age dummies as a proxy for “duration” are in general silent about this issue, as well as several panel probit models⁴⁰ that include age dummies. Other models avoid the use of age dummies and use a nonlinear function of age⁴¹. If however social norms would lead to retirement at specific ages like 60 or 65, a nonlinear function of age risks not to fully capture social norms. In addition the goodness-of-fit may simply be better if using age dummies. Since the only thing that interests us is actually the measurement of the impact of incentives on behaviour (and not the measurement of social norms), we prefer a priori a

³⁷ If we would allow it to be time-varying in order to allow upward wage increases it would be zero for those relying on replacement incomes implying that the unemployed, early retired and disabled do not like to work and have all exactly the same preferences for leisure what is a strong assumption and decreases variability of this variable across individuals.

³⁸ see appendix.

³⁹ See Euwals-Vanvuren-Wolthoff(2006).

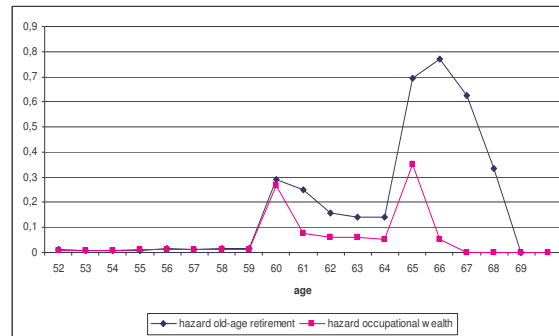
⁴⁰ Piekkola-Deschryvere(2004), Börsch-Supan(2003), Berkel-Börsch-Supan(2003),....

⁴¹ Meghir-Whitehouse(1997), Spataro(2002).

nonlinear specification of age variable. Following Grüber-Wise(2004) we estimate however two specifications of the retirement model: a model with a non-linear function of age and a model including age-specific dummy variables. This allows to test whether the coefficient of SSW is robust to the specification of age variable⁴².

A final endogeneity issue that we consider refers us back to Feldstein(1974) who introduced the idea that if workers accumulate more wealth in order to afford themselves to retire early, then the impact of social security on savings is ambiguous: decreased savings due to the tax and wealth transfer effects may be offset the increased savings due to the early retirement effect. We do not aim to model the labour supply decision simultaneously with the savings decision: we do not have data for it. Nonetheless, figure 16 shows the hazard rate of withdrawing occupational pension wealth⁴³ with the hazard rate in old-age retirement. Their shape is very similar and suggests that the decision to dissave and to retire in the old-age pension system should be modelled simultaneously.

Figure 16: Withdrawal of occupational pension wealth and old-age retirement by age



Stock-Wise(1990) and others argue that to measure the impact of social security policy it is important to treat occupational pensions and retirement as joint outcomes. In particular Stock-Wise(1990)⁴⁴ demonstrate that for individuals with pension plan availability changes in social security policy will have very little effect. Although the median pension plan may not

⁴² We also tested if no age variable is included whether the incentives measures alone capture the important peaks in retirement at age 60 and 65 and to what extent the age variable may absorb eligibility rules. The sign of SSW becomes negative suggesting that leisure is an inferior good. This is a major reason why we did not use these estimation results for our simulation. An explanation may be that the age variable captures unobserved preferences for work or preferences for leisure. Note that this idea has already been exploited by structural models of retirement.

⁴³ Private assets are not the same as occupational pension wealth. The latter can indeed be considered as a form of forced savings while private assets are voluntary savings. Nonetheless, under the hypothesis that private-sector employees that have high occupational pension wealth are also the ones that have private assets while private-sector employees without occupational pension wealth risk to have no private assets either, we consider occupational pension wealth as a proxy for private assets.

⁴⁴ See also Mitchell-Fields(1984) for the US, Euwals-Vanvuren-Wolthoff(2006) for the Netherlands, Meghir-Whitehouse(1997) and Blundell et alii.(2002) for the UK.

provide early retirement incentives, pension plan provisions may contribute importantly to the observed labour force decline if some plans provide such incentives⁴⁵. The following table shows the distribution of occupational wealth that is withdrawn by those who retire by retirement age. For those people that are entitled to occupational pension wealth it concerns in 12% of the cases amounts that outweigh old-age pension wealth.

Table 2: distribution of occupational pension wealth among those who retire(in euro) by age				
	mean	90 th percentile	75 th percentile	50 th percentile
60	40413	144934	26045	0
61	23169	93378	51	0
62	42807	117013	38530	0
63	36128	76458	3900	0
64	21706	34716	0	0
65	59672	109943	37931	0
66	13520	44673	3966	0

Unfortunately, we have only data on the amount of occupational wealth that is withdrawn but no data on the accumulation of occupational pension rights. We are thus unable to calculate accruals for occupational pension wealth. This is especially regrettable since the Belgian fiscal treatment of occupational pension wealth provides strong incentives to withdraw at the age of 60: the taxation of occupational pension wealth is extremely generous from the age of 60 on and fiscal legislation stimulates the design of pension plans that use 60 as normal retirement age after a career of 40 or 35 years.

The relationship between private wealth and labor market transitions has been studied for the working-age population in a job-search model by Bloemen-Stancanelli(2001). They estimated a simultaneous-equations model of reservation wages, labor market transitions and wealth, while allowing for correlation among the unobserved effects in the error terms of the equations. Interestingly, wealth enters the model as one of the simultaneous equations and as an explanatory variable in the reservation-wage equation. As the authors note, “If wealth is correlated with unobserved individual specific characteristics that also affect the job-offer probability, the estimated effect of wealth on the transition probability may not represent solely the effect of wealth on individual preferences. Therefore, wealth is allowed to affect the job-finding probability indirectly via the reservation-wage equation and via possible error

⁴⁵ As Samwick (1998) points out for the US, the median occupational pension wealth is zero because only 30% of his sample is covered by occupational pension plans but nonetheless these are more important in explaining retirement behaviour than social security.

autocorrelations". Since occupational wealth may be determined simultaneously with y^* and by the same variables x_{it} we extend our retirement model in a similar direction⁴⁶: we estimate the retirement decision simultaneously with an occupational pension wealth-equation and include occupational pension wealth as explanatory variable in the retirement equation:

$$y_{it}^* = \beta x_{it} + f(d) + c_i + \gamma OW_{it} + u_{it}$$

$$\log(OW_{it}) = \alpha z_{it} + c_i^{OW} + \varepsilon_{it}$$

With $\log(OW_{it})$ the log of occupational pension wealth withdrawn by individual i at t , α the vector of coefficients associated with $z_{it} (\neq x_{it})$, a vector of exogenous and possibly time-varying explanatory variables that will be discussed below, ε_{it} a normally distributed random error term and c_i^{OW} an individual-specific time-constant unobserved effect. The unobserved effects of the two equations may be correlated according to a bivariate normal distribution with mean zero. We will test the endogeneity of occupational wealth on the basis of the covariance between the unobserved effects of the cross-equations, denoted $\rho = \text{cov}(c_i, c_i^{OW})$.

Bloemen-Stancanelli(2001) use a normal distribution for wealth and a quadratic function of wealth as explanatory variable in the reservation-wage equation, although they clearly demonstrated that their wealth data are not-normally distributed. We use instead a lognormal transformation, since the distribution of wealth in our sample is highly skewed. There remains the question of what to do with the mass of individuals who have zero wealth since the log of zero is minus infinite. In case of zero wealth one often⁴⁷ puts $\log(OW_{it}) = 0$ what leads to a truncated distribution. By doing so, one retains all individuals in the sample. Diamond-Hausman(1984) omit individuals with low wealth and apply a Heckman(1979) correction for truncated samples. This is of course not an option for us since we are also interested in the retirement behaviour of those who will not withdraw occupational wealth. To avoid infinite dependent variables, Burbidge-Magee-Robb(1988) propose to use the inverse hyperbolic sine transformation to transform the level of net wealth

into $g(OW_{it}, \theta) = \frac{\log(\theta OW_{it} + (1 + \theta^2 OW_{it}^2)^{1/2})}{\theta}$ with θ a parameter to be estimated. It has the

⁴⁶ This is the reverse as Diamond-Hausman(1984) who analysed the individual lifecycle (dis)saving path while accounting for the fact that retirement might be endogenous to the (dis)savings decision (in the hypothesis that individuals who retire early may accumulate more wealth).

⁴⁷ F.e. Engen – Gale(2000).

advantage to treat zero and negative values of wealth and approximates the logarithm in its right tail.⁴⁸ This distribution has also weaknesses, as noted by Jenkins-Jantti(2005, p.25): “If the functional forms are defined also for values of zero, the density typically has zero mass at that point and so cannot capture any spike at that point.” Besides reshaping the distribution of wealth (choice of a normal, lognormal or inverse hyperbolic sine function), one could also rescale the distribution of wealth (f.e. $OW_{it}/1000$ or $OW_{it}/100$ or $OW_{it}/10$). It appeared that rescaling has no effect at all on the other estimated coefficients of the model (in particular no effect at all on SSW and accrual) but reduces the residual variability and improves the fit considerably. After experimenting with various rescaling and reshaping scenarios, the best fit is obtained when we convert OW_{it} into yearly annuities. For the wealth equation, we take therefore the lognormal transformation of these yearly annuities.

To identify the model, z_{it} should include besides the explanatory variables of x_{it} at least one exclusion restriction. Good exclusion restrictions should only affect the amount of occupational pension wealth an individual may receive while it may have no effect on the old-age retirement decision⁴⁹. We used as exclusion restrictions in the occupational wealth equation a dummy for blue-collar worker and dummies for sector of activity (both measured in 1991) that were insignificant in the old-age retirement equation and are used as exclusion restrictions. The idea is that being white collar and working in specific sectors is related to membership of an occupational pension plan⁵⁰.

4.2. Estimation results

The estimated coefficients with standard errors (and average marginal effects in **bold**) in parentheses are in table “. Standard errors are adjusted for serial dependence at the level of the individual.

<p>Table 3: Discrete-time hazard model for receipt of old-age pension benefits and occupational pension wealth</p>

⁴⁸ A first application is Bloemen(2008) who transforms in this way the dependent variable in a net wealth equation and uses net wealth/10000 as explanatory variable in a logistic retirement equation. Another application is found in Kapteyn-Panis(2006) who estimated only a net wealth equation with $\theta=1$.

⁴⁹ According to Bloemen(2008), “good exclusion restrictions are notoriously hard to find in a lifecycle model in which variables are jointly determined”. He includes one lag of net disposable household income as exclusion restriction which had a significant effect on the level of wealth. It is difficult to find useful examples of exclusion restrictions in a wealth equation in the literature.

⁵⁰ Berghman et al.(2004) confirms these are one of the characteristics of members of occupational plans in Belgium.

Dependent variable	Quadratic age trend		Age dummies	
	Retirement equation	Log(OW _{it})	Retirement equation	Log(OW _{it})
Intercept	42.574** (10.69)	82.751** (6.71)	-5.303** (0.38)	-0.669** (0.11)
Retirement incentives				
SSW/1000	0.00011** (0.00004) -0.008	0.000128** (0.00001)	0.000168** (0.0005) -0.011	0.0001** (0.00000)
Accrual/1000	-0.0044** (0.0003) +0.32	-0.0012** (0.00008)	-0.0259** (0.0003) +0.218	-0.0007** (0.00006)
Duration career	0.006 (0.007)		0.006 (0.008)	
OW _{it}	0.000002** (0.000000)		0.0000027** (0.000000)	
Lifecycle wages/1000	-0.0027** (0.0001)	-0.00023** (0.00004)	-0.0022** (0.0002)	-0.00011** (0.00004)
Age of the individual				
Age	-1.986** (0.36)	-3.075** (0.24)		
Age ²	0.020** (0.003)	0.028** (0.002)		
Age 54			0.128 (0.21)	-0.020 (0.01)
Age 55			0.039 (0.22)	0.043 (0.02)
Age 56			0.545** (0.20)	0.006 (0.02)
Age 57			0.257 (0.23)	-0.026 (0.02)
Age 58			0.331 (0.25)	-0.024 (0.03)
Age 59			0.491** (0.25)	-0.095* (0.03)
Age 60			3.28** (0.14)	2.224** (0.13)
Age 61			3.506** (0.16)	0.930** (0.13)
Age 62			3.140** (0.20)	1.015** (0.17)
Age 63			3.156** (0.23)	1.091** (0.20)
Age 64			3.293** (0.26)	1.019** (0.22)
Age 65			5.910** (0.26)	6.793** (0.44)
Age 66			6.793** (0.44)	3.369** (0.75)
Age 67			7.261** (0.74)	0.074 (0.18)
Age 68			5.675** (1.25)	4.785** (3.41)
Age difference	-0.0076 (0.007)	0.005* (0.002)	0.0021 (0.009)	0.005* (0.002)
Education level of individual				
Secondary	-0.167 (0.09)	-0.107** (0.03)	-0.265** (0.167)	-0.08** (0.02)
High school (3 years)	-0.585**	-0.165**	-0.774**	-0.128**

	(0.158)	(0.05)	(0.18)	(0.04)
High school (5 years) or university)	-0.963** (0.207)	-0.124** (0.06)	-1.018** (0.23)	-0.097** (0.05)
Sectoral activity of individual				
Energy, chemical industry		0.238 (0.11)		0.159 (0.101)
(Metallic) and other industries		0.272* (0.11)		0.199 (0.09)
Construction		0.243* (0.11)		0.164 (0.09)
Horeca		0.170 (0.114)		0.110 (0.10)
Transport and communications		0.173 (0.11)		0.136 (0.105)
Banking insurance		0.324** (0.11)		0.253 (0.106)
International institutions, public administration		0.266* (0.136)		0.184 (0.12)
R&D, teaching		0.033 (0.11)		-0.016 (0.104)
Socio-cultural sector		0.050 (0.120)		0.0034 (.106)
Others		0.159 (0.116)		0.096 (0.10)
Blue-collar worker		-0.095** (0.02)		-0.093** (0.02)
Dummy for having been unemployed at least once	0.007 (0.08)	0.002 (0.02)	-0.010 (0.10)	0.011 (0.02)
Dummy for having been disabled at least once	-0.219** (0.08)	-0.029 (0.022)	-0.219** (0.09)	0.020 (0.01)
Number dependent disabled	0.141 (0.105)	-0.069* (0.03)	0.088 (0.11)	-0.084** (0.03)
Number dependent children	-0.045 (0.07)	-0.029** (0.012)	-0.004 (0.07)	-0.025** (0.01)
Housing wealth/1000	-0.00027 (0.0004)	-0.00002 (0.0002)	-0.00052 (0.0006)	0.00003 (0.0002)
Region				
Wallonia	-0.232** (0.08)	-0.029 (0.02)	-0.293** (0.09)	-0.020 (0.02)
Brussels	-0.066 (0.11)	-0.032 (0.047)	-0.182 (0.13)	-0.017 (0.04)
Year dummies				
1991	-0.008 (0.242)	0.0009 (0.02)	0.083 (0.31)	0.011 (0.02)
1992	0.368 (0.217)	0.068* (0.029)	0.59* (0.28)	0.084** (0.026)
1993	0.488* (0.213)	0.127** (0.032)	0.722** (0.28)	0.122** (0.02)
1994	0.819** (0.206)	0.244** (0.036)	1.068** (0.27)	0.203** (0.03)
1995	0.455* (0.209)	0.077* (0.036)	0.846** (0.28)	0.135** (0.03)
1996	1.078** (0.205)	0.103** (0.035)	1.587** (0.27)	0.156** (0.03)

Covariance estimate unobserved effect	0.48 (0.01)	0.397 (0.01)
-2Log Likelihood	289452	280174
Number observations	48820	48820
*denotes significance at 5%level, ** denotes significance at 1%level. Standard errors in parenthesis. The reference individual lives in Flemish region, primary education level, without children or disabled dependants, has not been disabled, has not been unemployed, unknown sectoral activity, white-collar in 1990.		

The most interesting for us is the effect of retirement incentives on labour supply behaviour. The incentive measures have a significant impact on the probability of retirement. The estimated coefficient of SSW is positive: this suggests that leisure is a normal good and the probability to retire increases if the individual expects to receive a higher amount of lifetime wealth in the future.⁵¹ The estimated coefficient of the accrual is negative, suggesting a negative substitution effect. This means that if leisure becomes relatively less expensive than consumption, individuals substitute consumption by leisure.

The coefficients of a non-linear model show the sign of a change in an explanatory variable but do not allow to interpret the magnitude of this change. Usually in duration models, one calculates hazard ratios (in case of an extreme value distribution of error term) or odds ratios (in case of a logistic distribution of the error term) to interpret the coefficients. The calculation of marginal effects is common in binary panel models⁵² but not in duration models⁵³. We follow the approach of Euwals-Wolthoff-Vanvuuren(2006)⁵⁴ to calculate marginal effects in duration models as the change in expected retirement age resulting from a marginal change in an explanatory variable. This quantity can be calculated for each individual and then one can take the average of all individuals. In the age dummy estimation, a marginal increase of SSW (resp. accrual) with 1000 euro decreases (resp. increases) the expected retirement age with 0.011 years (0.218 years). In the age trend specification, an increase of SSW (resp. accrual) with 1000euro decreases (resp. increases) the expected retirement age with 0.008 years (resp. 0.32 years).

⁵¹ In the NBER research project, Gruber-Wise(2004) note that “the estimated effect of SSW however is often not statistically different from zero and in many cases is of the wrong sign”. Dellis et al.(2004) that do the estimation for Belgium find a negative coefficient of SSW, although they also included average lifecycle wages. The difference is that in the NBER research project SSW accounts for all retirement pathways and in addition for the civil servants and self-employed and they do not correct for a selection effect in the composition of the sample over time. On the contrary, we limit our analysis to the old-age pension system of private sector employees (what reduces measurement errors) and correct for the fact that the sample may be over time composed of individuals with a higher propensity to work. Piekkola-Deschryvere(2004) found on the basis of the PSBH for Belgium also a negative sign of SSW.

⁵² See Wooldridge(2002) for several examples.

⁵³ Diamond-Hausman(1984) and Meghir-Whitehouse(1997) calculate elasticities to interpret their results.

⁵⁴ P.29-30.

We found that if we omit the variable average lifetime wages the coefficient of SSW is negative. This suggests, as explained above, that higher lifetime earners will have higher levels of SSW but may also have greater preferences for work. If we control for average lifetime wages, the coefficient on SSW turns positive and the coefficient of average lifetime wages is negative. This means that the incentive effects may be misestimated if one does not control for omitted factors which are correlated with work preferences.

The age variable has as expected a strong effect on retirement probability. Replacing the age dummies by the quadratic age variable affects the coefficients of the incentive measures but not the other explanatory variables. This indicates that the age dummies or linear age trend may, besides age effects, also convey other information like health status or social norms. The fact that the age dummies are highly significant at the early and normal retirement age signals that the age dummies absorb some of the eligibility effects that should be captured by the accrual.

Individual observed characteristics such as a higher education level delay retirement. A reason may be that investment in human capital leads to more attachment to the labour market or that highly educated individuals are healthier and therefore work longer. The fact of having been disabled leads to a decrease of probability to retire in old-age pension system while this is not the case for having been unemployed. Indeed we observed that, for our sample, 50% of men transit from disability to old-age pension benefit after the age of 61 and 30% of men at the age of 65 while 35% of unemployed men transit from unemployment to old-age pension benefits after the age of 61 and only 10% at the age of 65. Note that employees living in Wallonia have a significant lower probability to retire in old-age retirement. This means that individuals living in Wallonia work longer or retire relatively more through other pathways.

The variable “duration of the career” decreases the coefficient of SSW. It is however insignificant. If we use “duration” and “squared duration” they remain completely insignificant: there does not seem to be a sorting effect, after controlling for observed and unobserved heterogeneity. We found that controlling for unobserved heterogeneity has almost no effect on the predicted hazard rates except for the ages 65, 66, 67 and 68 where the

predicted hazard rates with unobserved effect is much lower than the predicted hazard rate without controlling for unobserved effect.

The correlation between the unobserved effects of the retirement and wealth equation is positive and strongly significant: there are unobserved factors that at the same time induce individuals to retire and to dissave. A formal likelihood ratio test⁵⁵ of significance of the covariance parameter estimates confirmed that the model that allows for correlation between the unobserved effects is clearly to be preferred to the one that does not.

In the occupational wealth equation, age dummies become highly significant at the age of 60 that is the age at which the fiscal treatment of occupational pensions becomes very generous. Secondly, the fact of having dependent children delays, *ceteris paribus*, the decision to take up occupational wealth but is not significantly related to the decision to claim old-age pension benefits. The number of disabled in the household decreases the probability that one will withdraw occupational pension wealth. This may be because members of the second pillar are more likely to be healthy individuals or because the presence of a disabled partner, that could be associated to increased costs, may delay the decision to quit the labour market and to depend on replacement income. Finally, as expected, it was found that being white-collar and working in the banking-insurance sector is highly explaining eligibility for occupational pension wealth. We tested the includability of these dummies in the wealth equation: $2LogLik_{UR} - 2Loglik_R = -280174 - (-280235) = 61$. Since this value exceeds the critical value with $Q=11$, we reject H_0 that they cannot be included.

4.3. Predicted retirement age

In this section, the estimated coefficients are used to predict retirement probabilities where the retirement incentives (SSW, accrual) correspond to the ones of a reformed old-age pension system. The resulting retirement probabilities are then compared with the ones that were predicted in the status quo.

⁵⁵ Under H_0 , $\chi^2_1 = 395,3$ and $(\text{Prob} > \chi^2_1) < 0.0001$.

Section 3 explained that the 5% adjustment of pension benefits leads to a less negative accrual for all ages while it leads to less SSW before age 65 and more SSW after age 65. Given the sign of the estimated coefficients, both the substitution and the income effect predict a higher retirement age under this reform. For the same reasons one expects that the lump sum reform predicts a higher retirement age.

The pension bonus leads on the one hand to a higher SSW for every age of retirement after age 60, compared to the status quo. We therefore expect the income effect to induce individuals to retire sooner. On the other hand, it leads to a less negative accrual for retirement ages between 60 and 65. This substitution effect will stimulate individuals to postpone retirement. The substitution and income effect work therefore in the opposite direction and one has to look at the empirical results to see what effect dominates.

Figures 17-18 illustrate the predicted hazard rates after the reforms in the old-age pension system together with the predicted hazard rates in the status quo.

Figure 17: predicted hazard rates (age dummy)

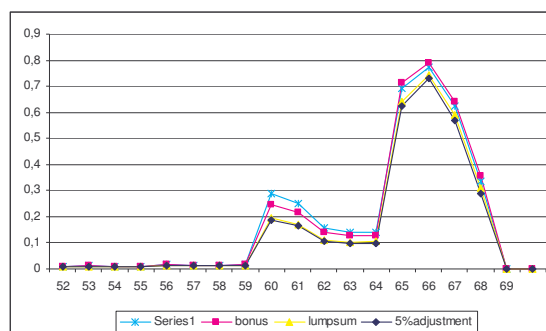
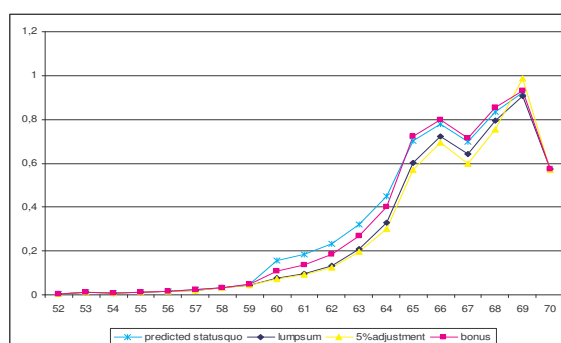


Figure 18: predicted hazard rates (quadratic age)



On the basis of the predicted hazard rates the predicted average retirement age can be calculated.

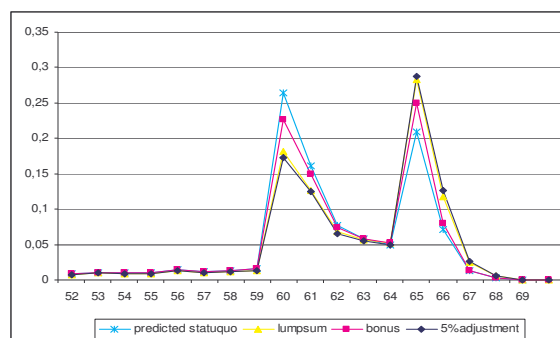
Table 4: observed and predicted retirement age				
Observed ⁵⁶	61.82 years			
	Status quo	5%reform	Lumpsum reform	bonus
quadratic age	61,82	62,915	62,840	62,18
age dummy	61,88	62.80	62,7237	62,13

Moving towards actuarial fairness at the margin increases the average retirement age with 1.1 years in the 5% adjustment reform and lump sum reform and only 0.3 years for the bonus. Note that if occupational pension wealth would be taxed higher in case of early withdrawal before age 65, this would in our model lead to a higher expected retirement age.

4.4. Budgetary impact

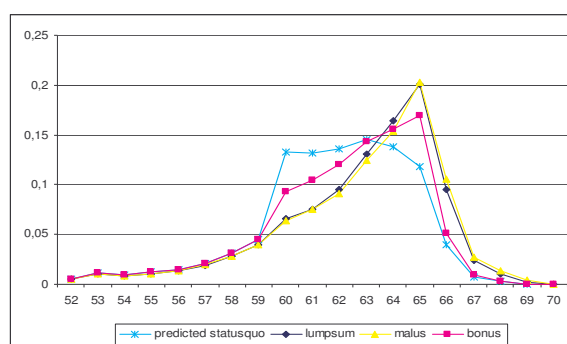
The next question is whether these reforms alleviate the pressure on the financial sustainability of pay-as-you-go systems in Belgium. In order to estimate the impact of pension reforms on the government budget one first calculates the distribution of retirement ages in the status quo and under the reform. The shift in the distribution of the retirement ages before and after a reform is very similar in figures 19-20 for the 5% reform and lump sum reform. For the bonus reform recently implemented by the Belgian government the distribution of retirement ages shifts less. Secondly, one calculates for both distributions of retirement ages, the SSW and present discounted value of payroll taxes in the old-age pension system that corresponds to each of the ages in the distribution.

Figure 19: distribution of retirement ages (age dummy)



⁵⁶ Note that the predicted retirement age refers only to those who retire through the old-age pension system. A retirement age taking into account exits into unemployment, early retirement and disability like Desmet-Jousten-Perelman-Pestieau(2003) would be much lower. They observed a retirement age of 58.38 for men and 57.43 for women on the basis of the same data as we work on.

Figure 20: distribution of retirement ages (quadratic age)



Then we calculate a weighted SSW and a weighted discounted sum of payroll taxes using the probability of retiring at a given age as the weight. The implications of the pension reforms for the government budget are summarized in table 5⁵⁷.

Table 5: Budgetary implications of pension reforms							
	Status quo	5% reform	Lumps sum reform	Bonus	5%	lumpsum	bonus
Mean SSW (euro)					%change relative to status quo		
quadratic age	134742	123524	124007	141101	-0.084	-0.080	+0.047
age dummy	134800	123395	123894	141011	-0.085	-0.080	+0.046
Mean discounted value of payroll taxes (euro) ⁵⁸					%change relative to status quo		
quadratic age	52518	57350	56964	54250	+0.092	+0.085	+0.03
age dummy	52820	56778	56440	54038	+0.075	+0.070	+0.02

First of all, the pension bonus has, as expected, a very limited effect on the government budget. Since it increases government expenditures on pension benefits more than it increases government revenues through higher payroll taxes, it seems to exacerbate the unsustainability of the pension system⁵⁹. This contrasts with the 5% reform that increases fiscal revenues since on the one hand it leads to a decrease of expenditures on net pension benefits with 8.50% and on the other hand an increase of revenues on payroll taxes with 9%. The lump sum reform has a similar effect.

⁵⁷Desmet-Jousten-Perelman-Pestieau(2003) predicts for the 6% adjustment reform an increase of payroll taxes between 5-11% and a decrease of benefits of 18-20%. This simulation is based on a weighted SSW for all retirement pathways (unemployment, disability, old-age pension, early retirement schemes) and not only for private-sector employees but in addition for civil servants and self-employed.

⁵⁸ The discounted sum of payroll taxes over ages takes 52 as the starting age.

⁵⁹ Also the Study Commission for Ageing estimated in her rapport of 2007 increased pension expenditures for the government in 2007-2013 due to the pension bonus.

The total effect of a reform on the government budget can in fact be decomposed in two effects: first, a direct effect by changing payroll taxes and benefits for a given work history (the “mechanical” effect) and second, an indirect effect through labour supply responses to the reform (the “behavioural” effect). To show this, we first express the total effect of the reform as follows:

$$total\ effect = \sum_{s=1}^T P_s^R SSW_s^R - \sum_{s=1}^T P_s^B SSW_s^B$$

with P_s^R the probability of retiring at age s under the reformed pension system and P_s^B the probability of retiring at age s under the status quo. Then decompose the total effect by adding and subtracting a term:

$$totaleffect = \left(\sum_{s=1}^T P_s^R SSW_s^R - \sum_{s=1}^T P_s^B SSW_s^R \right) + \left(\sum_{s=1}^T P_s^B SSW_s^B - \sum_{s=1}^T P_s^B SSW_s^B \right)$$

The first bracket contains the behavioural effect and the second bracket the mechanical effect.

Both the mechanical and behavioural effect are simulated on the basis of the labour supply responses estimated in the previous section. The idea is to calculate first the expenditures (net pension benefits) and revenues (payroll taxes in the old-age pension system) for the government under the current system and under the reformed system under the hypothesis there is no effect on labour supply. This is the mechanical effect. Then we compare this with the total effect on government budget shown in table 8. The behavioural effect is the difference between the total effect and the mechanical effect. It is entirely due to the shift in the distribution of retirement ages. The decomposition of the fiscal implications in a mechanical and behavioural effect is shown in table 6.

Table 6: Decomposition of budgetary implications into mechanical and behavioural effect									
	5% reform			Lump sum reform ⁶⁰			Bonus		
	Behavioural	Mechanical	Total	Behavioural	Mechanical	Total	Behavioural	Mechanical	Total
Mean SSW									

⁶⁰ The mechanical effect of the lumpsum and 5% adjustment reform is not exactly the same although the lumpsum amount was chosen such that, under the hypothesis of no labour supply adjustment, it has the same budgetary impact as the 5% adjustment reform. This is because the adjustment of gross pension benefits takes place before the application of the progressive income tax. This generates changes in the income distribution. We go further on this in 4.5.

quadratic	1000	-12218	-11218	590	-11325	-10735	-268	6626	6358
age									
dummy	828	-12233	-11405	517	-11422	-10905	-170	6380	6210
Mean discounted value of payroll taxes									
quadratic	4830	0	4830	4444	0	4444	1730	0	1730
age									
dummy	3956	0	3956	3618	0	3618	1216	0	1216
Total effect of mean SSW and mean discounted payroll taxes									
quadratic	5830	-12218	-6388	5035	-11325	-6290	1462	6626	8089
age									
dummy	4784	-12233	-7449	4135	-11422	-7287	1046	6380	7426

It shows that penalizing early retirement has a considerable impact on retirement behaviour. The behavioural effect, that accounts for 1/3 of the total effect, shows that people are prepared to work longer in order to maintain high pension benefits. It remains however counterbalanced by a considerably higher mechanical effect that accounts for 2/3 of the total effect.

Since the reforms concern purely the calculation of pension benefits they have no mechanical impact on the payroll taxes. However, due to the fact that people report the retirement decision, they pay payroll taxes during a longer period. This has a considerable effect on government revenues, at least for the 5% adjustment and lump sum reform, and is a pure behavioural effect.

The fact that the pension bonus, that is recently implemented in the Belgian old-age pension system, exacerbates the burden on the government budget is purely because the mechanical effect outweighs the behavioural effect. Thus whether or not the bonus has a behavioural effect, it will exacerbate the burden on the government budget, due to the mechanical effect.

Note also that the budgetary implication of the behavioural effect of the bonus is slightly negative (-268 and -170) for SSW while clearly positive for payroll taxes⁶¹. The reason is that expected SSW under the bonus reform decreases sharply at the age of 65 (see figure 14)

⁶¹ Desmet-Jousten-Perelman-Pestieau(2003) finds similarly a slightly negative behavioural effect on mean SSW when they simulate the absence of the assimilation of periods of inactivity in the Belgian old-age pension system. To explain this, they decompose the budgetary implication of the behavioural effect by age of retirement, by distinguishing the probability change by age and the expected SSW by age.

after which the pension bonus is not attributed anymore. At the same time there is a shift in the distribution of retirement ages so that proportionally more individuals are predicted to retire after age 65. For those individuals, the expected SSW after age 65 with bonus will be lower than in the predicted status quo before age 65 without bonus.

4.5. Redistributive impact for the old-age retired

Ultimately what interests us is the impact of the previously discussed pension reforms on income inequality among the retired taking into account individual labour supply effects. Since these results may be sensitive to the measure of inequality, different measures of income inequality are considered: the Gini coefficient, Atkinson index and interquartile ratio.

To present the situation schematically, let us distinguish three types of individuals indexed by $j = L, M, H$ for respectively low, medium and high income individuals. Their respective gross pension benefits in a pay-as-you go system can be described as:

$$P_L = \tau(1 - \alpha)\bar{w}(1 - \bar{l})$$

$$P_M = \int_0^{R_M} \tau \alpha w_{Mt} (1 - \bar{l}) dt + \tau(1 - \alpha)\bar{w}(1 - \bar{l})$$

$$P_H = \int_0^{R_H} \tau \alpha w_{Ht} (1 - \bar{l}) dt + \tau(1 - \alpha)\bar{w}(1 - \bar{l})$$

with $\bar{w} = \int_0^{R_L} \pi_L w_{Lt} dt + \int_0^{R_M} \pi_M w_{Mt} dt + \int_0^{R_H} \pi_H w_{Ht} dt$ the average wage in the population, $0 < \tau < 1$ a

payroll tax rate, $1 - \bar{l}$ the fixed labour supply of an individual, R_j the retirement age for an individual of type j and $0 < \pi_j < 1$ the probability of being an individual of type j . One

assumes that $w_L = 0$. The factor $0 \leq \alpha \leq 1$ represents the degree to which the system is bismarckian or beveridgean. If $\alpha = 0$, $P_j = \tau\bar{w}(1 - \bar{l})$: all individuals receive the same pension irrespective of their contributions. The pension system is beveridgean. If $\alpha = 1$,

$P_j = \int_0^{R_j} \tau w_{jt} (1 - \bar{l}) dt$ the system is bismarckian.

The 5% reform is represented by a multiplicative factor ρ that affects the bismarckian part of gross pension benefits through a mechanical effect (ρ) and a behavioural effect ($R_j(\rho)$)

where $0 < \rho < 1$ and $\frac{\partial R_j}{\partial \rho} > 0$. The lumpsum reform adds to the bismarckian part of benefits

a term $K_M = K_H = K < 0$ while the bonus adds a term $K_M = K_H = K > 0$.

An income tax is applied on the bismarckian part of pension benefits consisting of an increasing marginal tax rate $0 \leq t(.) < 1$ such that $\frac{\partial t}{\partial P_j} \geq 0$ and the lowest rate equals 0:

$$t(P_L) = 0. \text{ Net pension benefits are then } P_{jN} = P_j(1 - t(P_j)).$$

In going from the gross to the net benefit different stages can be distinguished. First, the pension reform modifies gross pension benefits. Second, income tax is applied to these gross pension benefits in order to calculate net pension benefits. Third, in response to a change of net pension benefits, individuals might change labour supply. It seems interesting to measure income inequality that results from the mechanical application of the reforms and the final income distribution that takes into account their mechanical and behavioural effect.

To start, we discuss the mechanical effect of the reform that leads to a change of gross pension benefits without allowing people to change labour supply. The 5% and lumpsum reform reduce gross pension benefits. The lumpsum reform is relatively more penalizing individuals of type M than H. This is because the lump sum amount differs only by age cohort while the 5% adjustment of benefits depends on age and income. The bonus increases gross pension benefits and is relatively more increasing the wellbeing of individuals of type M than type H: $\tau \alpha w_M (1 - \bar{l}) + K > \tau \alpha w_M (1 - \bar{l}) \rho > \tau \alpha w_M (1 - \bar{l}) - K$ and $\tau \alpha w_H (1 - \bar{l}) \rho < \tau \alpha w_H (1 - \bar{l}) - K < \tau \alpha w_H (1 - \bar{l}) + K$. Second, both the 5% adjustment and lumpsum reforms decrease taxable income and thus tax liability and income tax revenues for the government. The lumpsum reform decreases the tax liability relatively less for individuals of type H than M. On the contrary the bonus increases taxable income, tax liability and thus income tax revenues for the government. The tax liability increases relatively more for individuals of type M than H. We find that, as far as the mechanical effect concerns and independently of the inequality index used, inequality decreases most for the 5% adjustment reform. This is explained as follows: the 5% and lumpsum reform reduces pension benefits

until eventually one reaches the level of means-tested benefits, the beveridgean component of the Belgian old-age pension system. Indeed, a lot of individuals of type M see their pension benefits reduced by a percentage that is effectively less than the percentage applied to individuals of type H since they reach faster the beveridgean level. On the other hand the bonus recently implemented by the Belgian government increases old-age pension benefits of individuals of type M relatively more than individuals of type H but at the same time the bonus leads mechanically to an increase of income inequality between those enjoying pension benefits (bismarckian part) (individuals of type M and H) and those relying on assistance benefits (beveridgean part) (individuals of type L).

About the behavioural effect, one might expect some reranking of individuals due to labour supply effects. For the 5% reform, the behavioural effect does increase income inequality a little bit. This suggests that the cut of pension benefits induces the individuals of type H relatively more to work longer in order to avoid the cut of pension benefits. Our estimations suggest thus that $\left| \frac{\partial R_H}{\partial \rho} \right| > \left| \frac{\partial R_M}{\partial \rho} \right|$ such that high income individuals react more to retirement incentives than low income individuals. For the lumpsum reform and the bonus⁶², the behavioural effect marginally decreases income inequality, independently of the inequality index used. This suggests that a lumpsum adjustment does not give enough incentives to individuals of type H to work longer and receive higher pension benefits.

Since the mechanical effect outweighs the behavioural effect, the 5% reform leads in total to the lowest degree of income inequality among the retired independently of the inequality index used. This is a rather surprising result but has mostly to do with the fact that these reforms do not affect means-tested benefits.

Finally, one has to realize that if the number of pensioners increases over time, the amount of money raised for the government by the 5% or lumpsum reform would have to be distributed among an increasing number of pensioners. Thus the amount would decrease over time and induce a redistribution among different cohorts retiring at different times. The bonus will instead, due to demographic ageing, increase the budgetary cost for the government over time. Only in the absence of demographic ageing, there will be no redistribution among cohorts.

⁶² Note that due to different lumpsum amounts, it is difficult to compare the lumpsum reform with the bonus.

Table 7: redistributive impact on old-age retired							
	Status quo	5%reform		Lump sum reform		Bonus	
Gini coefficient							
		Mechanical	Mechanical+ behavioural	Mechanical	Mechanical+ behavioural	mechanical	Mechanical+ behavioural
quadratic age	0.10	0.0891	0.0894	0.098	0.096	0.096	0.094
age dummy	0.10	0.0880	0.0885	0.098	0.096	0.096	0.095
Atkinson index							
$\varepsilon =0.75$							
quadratic age	0.0039	0.00312	0.00312	0.0038	0.0036	0.0036	0.0035
age dummy	0.0039	0.00305	0.00307	0.0038	0.0036	0.0036	0.0035
$\varepsilon =0.5$							
quadratic age	0.0078	0.00625	0.00624	0.0077	0.0072	0.0073	0.0070
age dummy	0.0078	0.00611	0.00613	0.0076	0.0072	0.0072	0.0071
$\varepsilon =0.25$							
quadratic age	0.0117	0.00937	0.00936	0.0115	0.0108	0.011	0.0106
age dummy	0.0117	0.00916	0.00919	0.0114	0.0109	0.0106	0.0106
Interquartile ratio							
quadratic age	1.30	1.268	1.269	1.298	1.293	1.284	1.277
age dummy	1.30	1.269	1.266	1.292	1.287	1.287	1.282

5. Concluding remarks

The old-age pension system for private-sector employees provides strong incentives towards retirement at the age of eligibility. The adjustment of pension benefits by 5% and the lumpsum reform reduce substantially these retirement incentives. The bonus, recently implemented in the Belgian old-age pension system, reduces the retirement incentives between age 60 and 64, but is not high enough to shift the peak in SSW from age 60 to age 65. Since it is only applied to the ages 60-65 it leads to a strongly negative accrual at age 65.

Further, the impact of these reforms on the retirement age, government budget and income distribution of the retired was examined. The 5% and the lumpsum reform increase the retirement age with 1.1 years. They reduce government expenditure on old-age benefits with 8.5% and increase government revenues from payroll taxes with 9%. This contrasts with the pension bonus. Since the amount of the bonus is so low and due to offsetting income and substitution effects, it only increases retirement age with 0.3 years. The bonus is expected to exacerbate the burden on the government budget.

The impact of reforms was predicted while accounting for simultaneity of the retirement decision with the decision to withdraw occupational pension wealth. One might expect that reforms of the old-age system have more impact if they were accompanied by a change of the eligibility rules and fiscal treatment of occupational pensions.

Ultimately when considering the redistributive impact of these reforms, the 5% adjustment reform leads to the lowest degree of income inequality among the retired. This is a rather surprising result that has mostly to do with the fact that these reforms only affect the Bismarckian part of pension benefits. In particular the 5% adjustment and lumpsum reform increase the number of people relying on means-tested benefits but the bonus instead increases the distance between those who have a larger part of Bismarckian pension benefits with those relying only on means-tested benefits. Finally, the behavioural effect increases income inequality a bit under the 5% adjustment reform but

it is outweighed by the mechanical effect. The 5% adjustment reform thus not only enhances financial sustainability of the system but at the same time decreases income inequality among the old-age retired at most.

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Appendix

The Belgian old-age pension system consists of 4 schemes. Three schemes are organised on a contributory base: the private-sector employees, the civil servants and the self-employed. The fourth category consists of means-tested benefits available from the normal retirement age⁶³.

The old-age pension system of private-sector employees that is financed on a pay-as-you-go basis allows for flexible retirement between 60 and 65⁶⁴ while it does not impose any actuarial adjustment of benefits on the choice of the retirement age. Nonetheless pension benefits increase by 1/45 for men and 1/40⁶⁵ for women as long as the employee has not reached a full career of 45 respectively 40 years.

The amount of pension benefits depends on the number of years worked as private-sector employee and the level of wages obtained during each year of that career. The number of years of the career consists of the sum of periods worked and spent on replacement income. Pension benefits are calculated for each year of the career on the basis of real wages and for periods spent on replacement income on the basis of a fictive wage. The latter is a fixed amount for periods during 1955-1967. Since 1967 fictive wages are based on the real wages in the last year of activity.

Wages above a price-indexed ceiling (44.994euro in 2007) are not taken into account for the calculation of pension benefits. This ceiling corresponds to the 85th percentile income in our dataset. Wages are for each year of the career price-indexed and since 1973 to the

⁶³ That is, for the means-tested benefit scheme until 1st July 1997, 65 for men and 60 for women. Since 1st July 1997, the age of eligibility for women gradually increased to 65 in 2009.

⁶⁴ Before 1st January 1991, the normal retirement age is fixed at 65 for men and 60 for women and retirement could be advanced by maximum 5 years at the cost of a reduction of benefits with 5% for each year of anticipation before the normal retirement age. Since 16 July 1986(Royal Decree 415) it was not allowed anymore for women to retire in the old-age system before 60. Since 1st January 1991, the actuarial adjustment of benefits is abolished. Since 1st July 1997, flexible retirement before the normal retirement age is conditional on a career of 20 years. The required number of years of the career gradually increased to 35 in 2005.

⁶⁵ Women are since 1st July 1997 in a transitory regime that increases the full career from 40 tot 45 years and the normal retirement age from 60 to 65 by the year 2009.

evolution of wages between the year of the career and the year of retirement.⁶⁶ From the moment the pension has been taken up, benefits are only adjusted to price inflation.

Benefits are thus computed according to the following formula:

$$\sum_{n=N-C}^{\min(N, N-C+Z)} \frac{1}{Z} * k * \min(w_n^{\max}, w_n) * \frac{I_N}{I_n}$$

Where n denotes a year during the career, Z the number of years of a complete career, N the year corresponding to the take up of the pension, C the number of years of the career, I_n the price or revaluation index corresponding to n, w_n^{\max} the wage ceiling corresponding to n, w_n real or fictive wages corresponding to n and k is a replacement rate equal to 75% or 60% depending on whether the beneficiary is married or single. Only married individuals of whom the partner does not receive any labour or replacement income are entitled to the 75% rate. The widow(er) obtains a survival benefit equal to 80% of the pension benefit of the former husband or spouse, calculated at the 75% rate. Note that while the age of eligibility for old-age benefits is 60 that survivor benefits are available from the age of 45 on.

In addition, when the career is complete, the benefit cannot be inferior to a price-indexed minimum. If the career is not complete but at least equal to two third of a complete career, the same amount but proportional to the length of the career is guaranteed.

Old-age pension benefits are subject to a health insurance tax of 3.55% and a solidarity tax between 0.5 and 2% depending on income⁶⁷. They are also subject to an earnings test. For earnings above a limit, pension entitlement is fully suspended. The limit is higher after age 65 and higher for survivor beneficiaries. The effective income tax rate on retired people is generally very low due to income splitting, tax allowances in function of household composition and tax deductions for replacement incomes.

⁶⁶ The adjustment to general wages gradually disappeared for pensions taken up after 1st July 1997.

⁶⁷ Since 1st January 1995.

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